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COAP 2014 Best Paper Prize

Each year, the editorial board of Computational Optimization and Applications (COAP) selects a paper from the preceding year's publications for the Best Paper Award. In 2014, 87 papers were published by COAP. The recipients of the 2014 Best Paper Award are Daniel Espinoza of the University of Chile and Eduardo Moreno of the Adolfo Ibáñez University, Chile, for their paper "A primal-dual aggregation algorithm for minimizing conditional value-at-risk in linear programs" published in volume 59 pages 617–638. This article highlights the research related to the award winning paper.

Nowadays, an increasing variety of stochastic optimization problems are tackled using the sample average approximation method [5,8]. Using this technique, a given stochastic optimization problem with an underlying (possibly continuous or even unknown) probability distribution can be approximated by solving a series of *sampled* problems which have, in turn, an underlying discrete distribution. Its accuracy depends heavily on the size of the used sample, leading eventually to very large optimization problems. However, it is commonly observed that the final solution behaves *similarly* on broad sets of samples, and moreover, the number of *groups* of scenarios with different behaviors is very limited. Thus, if it were possible to guess these groups of scenarios beforehand, a much smaller equivalent problem could be constructed.

A clear example of this behavior is the case of some risk measures such as CVaR [10,11]. Minimizing a CVaR objective function aims to identify the set of the worst performing scenarios that has a given probability weight, disregarding the remaining scenarios. In fact, this problem is equivalent to a robust optimization problem that uses a convex set based on the scenarios in the full sample [1,7,9].

This year's award paper [3] proposes an iterative algorithm that guarantees to identify a valid *grouping* of scenarios; while providing bounds on the optimal value for the problem. In each iteration, given a candidate grouping of scenarios, an aggregated problem is solved, providing a valid upper bound and a dual solution. This dual solution allows to compute a valid lower bound and, if these bounds differ, it provides a disaggregation of the candidate grouping. The ideas for the proposed algorithm come from the work of Bienstock and Zuckerberg [2] for production scheduling problems, which has had a big impact on mine planning problems [4].

An advantage of the proposed algorithm is that each aggregated problem is usually much smaller than the original problem, both in number of variables and in number of constraints, while the disaggregation of scenarios reduces to a simple ordering of a list of numbers. This makes each iteration of the algorithm very fast. Surprisingly, the experiments performed in the paper show that the number of iterations required to attain optimality is about a dozen, even with a hundred thousands scenarios. Moreover, when compared against other specialized methods, such as an adaptation of the L-shaped algorithm for this problem [6], the proposed algorithm is about ten times faster.

It is important to mention that the essential ideas in the paper are very general and they can be applied to other problems. In fact, they have already been extended to two-stage stochastic optimization with fixed recourse by Song and Luedtke [12]. The question of further possible extensions is still open.

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